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REGULATION IN VORTICELLA.

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It is a fact well known to students of regeneration that one part of an organism may exert a measurable influence over the growth and development of another. This has been demonstrated for many of the Metazoa under varying forms. The removal of the head of a planarian liberates, as it were, the post-jacent tissue, out of which a new head is fashioned. Among macruran crustaceans, the loss of the larger chela of an asymmetrical pair has been shown many times to be succeeded by an accelerated growth of the smaller chela and a subsequent retardation in the regeneration of the lost chela so that, in the presence of the small chela grown large, it remains the smaller of the two. Finally—not to multiply instances needlessly—when a short length of the column, with hydranth, is cut away from the hydroid *Corymorpha*, no development beyond closure of the wound occurs proximally until the hydranth is removed from the distal end. In this respect, the behavior of *Corymorpha* may be contrasted with the behavior of the planarian, since in the latter the presence of the original head on the anterior piece does not inhibit the development of a tail posteriorly. The hydranth in *Corymorpha* appears somehow to inhibit, in short pieces, even the development normally to be expected at the aboral end.

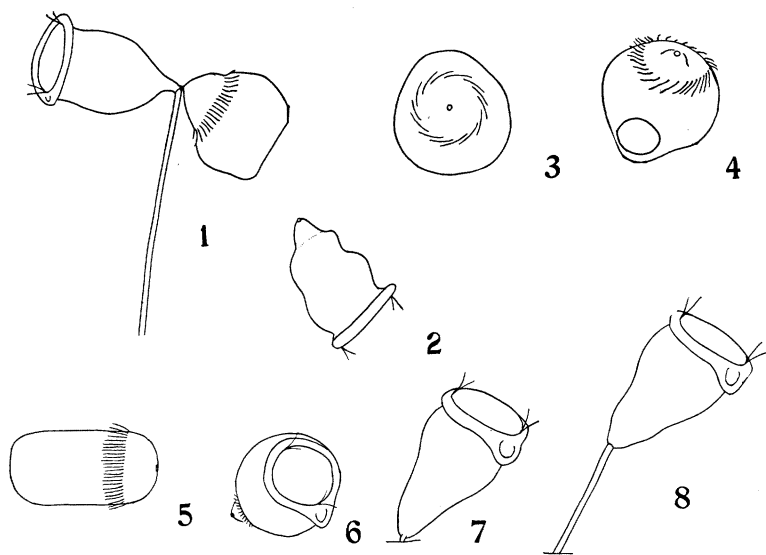
Among the Protozoa, instances of this last sort seem so generally to have escaped record, that we have thought it desirable to describe a similar domination in *Vorticella* sp. of one part over another.

When *Vorticella* divides, the fission plane passes approximately through the center of the organism from oral disk to a point immediately to one side of the contractile stalk. Of the zoöids thus formed, one remains attached to the original stalk, while the other swims away by means of cilia which, during the

last phases of the process of fission, have appeared in a circlet near the aboral pole (Fig. 1).¹

Why do such cilia not appear on the stalked zoöid?

It may be noticed in the last stages of fission that the zoöid destined to become free retains its connection by a slender protoplasmic strand with the body of the stalked zoöid, not directly with the stalk itself. This fact suggests what has proven to be the correct view, namely, that cilia which would normally develop on every individual are able to show themselves only when sufficiently isolated physiologically from the stalk. Such isolation exists when the connection between the separating zoöids is reduced to a narrow strand.



FIGS. 1-8.

This view was reinforced by the familiar fact that, upon becoming attached to the substrate, the free zoöid gradually loses its cilia as its stalk develops. In the normal life history, then, aboral cilia develop in isolation from the stalk and disappear with the development of the stalk.

The test was applied by cutting a stalked zoöid quite away from the stalk. This was accomplished under a binocular, by

¹ The figures have not been drawn with a camera. Their scale varies somewhat.

means of a sharp dissecting needle. A typical case is shown in Figs. 2-8. Soon after the cutting, the zoöid (Fig. 2) settled down on its oral surface. In an hour, cilia began to push out in a circlet near the aboral pole. They elongated rapidly, and began to beat around the oral-aboral axis (Fig. 3). The oral disk turned in upon itself in the manner characteristic of the normally free zoöid (Fig. 4). One hundred and five minutes after the operation, the zoöid swam away (Fig. 5), indistinguishable in every respect from the normally free form. After five minutes of active locomotion, it came to rest on its aboral end, became attached, and unfolded its oral disk (Fig. 6). At once the stalk began to grow and the aboral cilia to disappear. In ten minutes no aboral cilia were to be seen (Fig. 7). Two hours and a half later, the organism appeared as in Fig. 8.

The development of the stalk appears to be dependent on contact at the aboral end; while the development of aboral cilia is conditioned by physiological isolation from the stalk whether achieved experimentally or by a narrowing of protoplasmic connection in the ordinary course of fission.